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PATENT SPECIFICATION



DRAWINGS ATTACHED

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Date of filing Complete Specification: Nov. 6, 1957.

Application Date: Sept. 22, 1956. No. 29036/56.

Complete Specification Published: Oct. 19, 1960.

Index at Acceptance:- Classes 39(4), 0; 140, E1(C:H); and 141, VI (A1C1:1A6F2A:7B1).

International Classification:- A41d. 021.

COMPLETE SPECIFICATION

Improvements in or relating to the Coating of Cloth, Plastic or Other Pliable Material for the Protection of Personnel from Radiation

We, EVERGLADES LIMITED, a British Company of Spenwood Works, Littleborough, in the County of Lancaster do hereby declare the invention, for which we pray
5 that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

10 The present invention relates to the coating of cloth, plastic or other pliable material for the protection of personnel from X-Rays, gamma rays or the like radiation.

15 In the manufacture of protective shields and clothing it has been suggested to utilise fabrics coated with synthetic resins containing powdered radiation absorbing substances such as lead. Again in such manufacture use is
20 currently made of sheeting material made up of cloth and a composite layer having a rubber base, but including a high proportion of lead powder or lead oxide. In such known use the cloth is generally
25 located on both sides of the lead-rubber protective layer, although it is also known to provide the cloth on one side only of said layer, the other side of which may be covered separately. There
30 are a number of reasons which prompt this sandwiching of the protective layer. The most important of these are to provide adequate flexible support for the relatively heavy rubber, to prevent it
35 cracking, tearing or becoming distorted; to shield the lead-rubber composition from exposure and also to prevent it contaminating other materials with which it might otherwise come into contact;
40 to prevent deterioration of the rubber arising from contact with perspiration by the user; and where the material and its coating is made into gloves, to provide protection against secondary
45 radiation. Again in the case of gloves

it is known to provide leather outer gloves for inner gloves of the kind wherein the cloth is provided on one face only of the lead-rubber material so as to provide the
50 required protection against soiling of anything with which the inner gloves would otherwise come into contact.

In contradistinction the present invention provides a protective pliable screen, shield or article of clothing character-
55 ised in that either or both of the outer layers of a composite pliable sheeting material is constituted by, or includes, a plastic free from radiation-screening powdered material and the inner protec-
60 tive layer between said outer layers is made from lead, lead compounds, tungsten, or tungsten compounds in powdered form as radiation-screening powdered material incorporated in a heat gelled polymer
65 paste or other synthetic polymer.

Thus one of the outer layers may be of cloth, which may be appropriately coated with a plastic free from lead or other
70 radiation-screening powdered material, while the other outer layer may be of plastic, or again a pair of outer plastic layers, free from radiation-screening powdered material may be fixed or other-
75 wise formed on the protective layer.

By "plastic" is meant a synthetic polymer capable of being produced in pliable sheet form.

The expression "plastic free from lead" is used to indicate a plastic to which
80 no lead or compounds of lead have been added for the purpose of shielding from radiation. Small amounts of lead compounds may be present for other purposes, however, e.g. lead stearate for the pur-
85 pose of stabilisation during processing.

Conveniently the protective or intermediate layer of the sandwich sheeting is formed from a paste incorporating polyvinyl chloride polymer powder and
90

lead powder which may be spread upon the cloth or plastic outer layer constituting the flexible base of the composite sheeting.

5 This composite sheeting material provides a number of advantages over the known forms of construction. Thus the coating forming the, or each outer layer, is cheaper than cloth, it offers admirable strength and support for the lead-plastic layer forming the intermediate protective part of the sheeting, it presents a more hygienic finish and can be washed, and it may be appropriately coloured for the dual purpose of improving its appearance and also indicating, by a selected code of colours, the degree of protection which it offers, such as for example red in the case of a protection which is equivalent to a thickness of lead equal to 0.25 mm. and brown in the case of a protection equivalent to a thickness of lead equal to 0.5 mm.

25 The sheeting may be utilised in the manufacture of aprons, helmets, gloves or other articles of wearing apparel, or again of articles such as screens or shields.

30 The invention is more particularly described with reference to the accompanying drawings Figures 1 and 2 of which respectively illustrate by way of example a section through a three layered composite protective shield or sheeting material and a convenient form of apron made from said sheeting material.

35 In the drawings a cloth backing is shown at 10 and a base coating for the cloth at 11, these two constituting one outer layer of the composite sheeting material which is free from lead. The inner protective layer containing lead powder is shown at 12 and the final top coating or surface layer which is free from lead is indicated at 13.

40 The apron of Figure 2 has a front face constituted by the top surface layer 13 and a rear face formed by the coated fabric 10. It is of any desired size and may have a thickness as described in the examples given herein. It has a shoulder strap 14 extending between fasteners 15 on the top edge of the apron said strap being provided with an eyelet or stirrup 16 through which is passed a waist cord 17 secured at one end to the apron at 18 and adapted at its other end to be fastened to a buckle 19 after passing through the stirrup 16.

60 Preferably the protective layer 12 is formed from a paste made up of polyvinyl chloride polymer powder, a suitable plasticiser, a stabiliser and a high proportion of lead powder or

powdered compounds of lead, tungsten powder or powdered compounds of tungsten as suitable radiation-screening powdered material.

The said protective layer may be between 0.4 mm. and 3 mm. thick and may be applied in paste form to the cloth 10 or other flexible base by way of a number of coats. In this respect and in order to avoid the formation of bubbles or air pockets a large number of thin coats are preferred to a smaller number of relatively thick coats.

Similarly the covering layer 13 of plastic free from radiation-screening powdered material may be obtained by applying several coats of polyvinyl chloride to the protective layer 12.

Where the flexible base is of cloth 10 appropriately coated at 11, the said cloth may be of any type of woven or non-woven material, of which cotton, rayon or mixtures thereof are regarded as the most suitable. Again it may be of knitted material. Preferably the cloth is calendered before applying the base coating 11 to it.

One example of the mixture of parts by weight producing a sheeting material having a lead equivalent of not less than 0.25 mm. is as follows:-

Base coating 11 for the cloth 10 to form one composite outer layer.

Polyvinyl chloride polymer	450 parts	
Diocetyl phthalate	260 parts	100
Lead carbonate (stabiliser)	15 parts	

Lead composition 12 or inner protective layer.

Polyvinyl chloride polymer	45 parts	
Diocetyl phthalate	71 parts	105
Lead Stearate	4 parts	
Lead powder 100-200 mesh	per inch	880 parts

Final top coating 13 or other outer layer.

Polyvinyl chloride polymer	602 parts	110
Diocetyl phthalate	316 parts	
Lead Stearate (stabiliser)	28 parts	
Pigment (a) Red Oxide of Iron	20 parts	
(b) Blanc Fix	34 parts	

In such example the base coating 11 may be formed by a single coat having a thickness of 0.05 mm. and conveniently is applied to a cotton cloth backing having 85 ends of warp to 70 picks of weft and a weight of 5-ozs. to the square yard. The particle size of lead powder is between two thousandths and six thousandths of an inch. The lead composition 12 may have a thickness of 0.6 mm. made up from the application of five coats, whilst the final top coating or facing 13 may be of 0.15 mm. made up from two coats. The mixture in the case of each of the base and top coatings and also the lead composition may

be heated to a temperature of 110°C by hot air or by means of infra red rays so as to semi-gel one coat before another coat is applied.

5 Finally the sheeting as a whole is reheated to a temperature in the region of 180°C in order to complete the gelling operation and to convert the plastic mix to a tough and yet resilient final form.

10 A second example of mixture of parts by weight of a sheeting material having a lead equivalent of not less than 0.5mm. is as follows:-

Base coating 11 for the cloth 10.

15	Polyvinyl Chloride Polymer	450 parts
	Diocetyl phthalate	280 parts
	Lead carbonate (stabiliser)	15 parts

Lead Composition 12.

20	Polyvinyl Chloride Polymer	45 parts
	Diocetyl phthalate	71 parts
	Dibutyl Tin Dilaurate	
	(stabiliser)	1 part
	Lead Powder 100-200 mesh per	
	inch	880 parts

Final Top Coating 13.

25	Polyvinyl Chloride Polymer	602 parts
	Diocetyl phthalate	316 parts
	Dibutyl Tin Dilaurate	
	(stabiliser)	6 parts
30	Pigment: Brown Oxide of Iron	20 parts
	Blanc Fix	34 parts

Apart from differences in the substances forming the lead composition 12 and the top coating 13 this example differs from the first in that the lead composition is made up of eleven coats producing a total thickness of 1.8 mm.

Although the backing 10 for the base coating 11 in the examples is of cloth it will be appreciated that it may be of other material such as for example a material made from glass fibre, or again a synthetic fibrous material such as nylon or that sold under the Registered Trade Mark TERYLENE. Where it is of nylon, glass or TERYLENE material it is necessary to ensure that the fabric shall not readily peel from the plastic. This affinity may be achieved in known manner by impregnating or otherwise treating the nylon, glass or "Terylene" material with a bonding agent consisting of a dispersion in suitable organic compounds of plasticised polyvinyl chloride together with an epoxy type resin.

The required application of the respective coats may be achieved for

example with the aid of a knife spreading machine or by calendering or again by the use of a reverse roller machine.

WHAT WE CLAIM IS:-

1. A protective pliable screen, shield or article of clothing in which either or both of the outer layers of a composite pliable sheeting material is constituted by, or includes, a plastic free from radiation-screening powdered material and the inner protective layer between said outer layers is made from lead, lead compounds, tungsten or tungsten compounds in powdered form as radiation-screening powdered material incorporated in a heat gelled polymer paste or other synthetic polymer.

2. A protective screen, shield or article of clothing as claimed in Claim 1 in which one of the outer layers comprises a cloth with a plastic coating free from radiation-screening powdered material applied to it.

3. A protective screen, shield or article of clothing as claimed in Claim 1 in which one of the outer layers comprises a synthetic or other fibre and a plastic free from radiation-screening powdered material, the fibre being first treated to ensure affinity between it and the plastic to be applied to it so as to reduce the risk of peeling.

4. A protective screen, shield, or article of clothing as claimed in Claim 1 and when prepared in accordance with the first example herein.

5. A protective screen, shield, or article of clothing as claimed in Claim 1 and when prepared in accordance with the second example herein.

6. A protective screen, shield or article of clothing constructed substantially as described with reference to and as illustrated in the accompanying drawings.

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PROVISIONAL SPECIFICATION

No. 29036 A.D. 1956

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We, EVERGLADES LIMITED, a British Company of Spenwood Works, Littleborough, in the County of Lancaster do hereby declare this invention to be described in the following statement:-

The present invention relates to the coating of cloth, plastic or other pliable material for the protection of personnel from X-Rays, gamma Rays or the like radiation.

In the manufacture of protective shields and clothing use is currently made of sheeting material made up of cloth and a composite layer having a rubber base, but including a high proportion of lead powder or lead oxide. In such known use the cloth is generally located on both sides of the lead-rubber protective layer, although it is also known to provide the cloth on one side only of said layer, the other side of which may be covered separately. There are a number of reasons which prompt this sandwiching of the protective layer. The most important of these are to provide adequate flexible support for the relatively heavy rubber, and to prevent it cracking, tearing or becoming distorted; to shield the lead-rubber composition from exposure and thus prevent it contaminating other materials with which it might otherwise come into contact; to prevent deterioration of the rubber arising from contact with perspiration by the user; and where the material and its coating is made into gloves, to provide protection against secondary radiation. Again in the case of gloves it is known to provide leather outer gloves for inner gloves of the kind wherein the cloth is provided on one face only of the lead-rubber material so as to provide the required protection for said inner gloves against marking off.

In contradistinction the present invention is characterised in that either or both of the outer layers of a composite sheeting material, incorporating an inner protective layer containing lead powder or its equivalent, is constituted by a plastic free from lead.

Thus one of the outer layers may be of cloth and the other of plastic, or again a pair of outer plastic layers, free from lead, may be fixed or otherwise formed on the protective layer.

Where relatively thick composite sheeting material, substantially in the

nature of slabs, is involved these may be cast within moulds, in which event either or both of the sides of the mould may be covered with the plastic free from lead as a preliminary step in the casting process.

Conveniently the protective or intermediate layer of the sandwich sheeting is formed from a paste incorporating polyvinyl chloride polymer powder and lead powder which may be spread upon the cloth or plastic outer layer constituting the flexible base of the composite sheeting.

This composite sheeting material provides a number of advantages over the known forms of construction. Thus the coating forming the, or each outer layer, is cheaper than cloth, it offers admirable strength and support for the lead-plastic layer forming the intermediate protective part of the sheeting, it presents a more hygienic finish and can be washed, and it may be appropriately coloured for the dual purpose of improving its appearance and also indicating by a selected code of colours, the degree of protection which it offers, such as for example red in the case of a protection which is equivalent to a thickness of lead equal to 0.25 mm., green in the case of a protection equivalent to a thickness of lead equal to 0.5 m.m., and yellow of 0.75 mm.

The sheeting may be utilised in the manufacture of aprons, helmets, gloves or other articles of wearing apparel, or again of articles such as screens, shields or the like.

Preferably the protective layer is constituted by a paste made up of polyvinyl chloride polymer powder, a suitable plasticiser, a stabiliser and a high proportion of lead powder or powdered compounds of lead, tungsten powder or powdered compounds of tungsten.

The said protective layer may be between 0.5 mm. and 3 mm. thick and may be applied in paste form to the cloth or other flexible base by way of a number of coats. In this respect and in order to avoid the formation of bubbles or air pockets a large number of thin coats are preferred to a smaller number of relatively thick coats.

Similarly the covering layer of plastic free from lead or its equivalent may be obtained by applying several

coats of polyvinyl chloride to the protective layer.

Where the flexible base is of cloth, this may be of any type of woven or non-woven material, of which cotton, rayon or mixtures thereof are regarded as the most suitable. Preferably the cloth is calendered before applying the protective layer to it.

As an example reference is made to a suitable mixture which when finally gelled is substantially equal, from a protective aspect, to half its thickness of metallic lead. The mixture of parts by weight is as follows:-

Polyvinyl Chloride Polymer	45 parts
Diethylphthalate	71 parts
Lead Stearate	4 parts
Lead Powder	880 parts

In the application of the mixture a layer thickness of say 0.6 mm. may be applied in about six coats with the aid of a knife spreading machine and with the mixture heated to approximately 110°C. by hot air or by means of infra red heaters between each coat, so as to semi-gel or dry each of these before application of the next coat. When an intermediate or protective layer of this kind has been formed, a Polyvinyl Chloride layer pigmented, but containing no lead powder, is applied to it in one

or more coats, giving a thickness of approximately 0.1 mm. This layer conveniently may be made up by the following parts by weight:-

Polyvinyl Chloride Polymer	602 parts	
Diethylphthalate	216 parts	
Lead Stearate	28 parts	
Pigment	54 parts	40

Like the protective or intermediate layer this outer layer may be semi-gelled at substantially 110°C.

Finally the sheeting is reheated to a temperature of 180°C - 190°C, preferably 180°C, to complete the gelling operation and to convert the plastic mix to a tough and rubbery final form.

The expression "plastic free from lead" is used to indicate a plastic to which no lead or compounds of lead have been added for the purpose of shielding from radiation. Small amounts of lead compounds may be present for other purposes, however, e.g. Lead Stearate for the purpose of stabilisation during processing.

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